

Carbon Research at the University of Idaho

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I. Improving our knowledge of C cycling

A. Forested systems

Main goal: To develop a new generation of computer models that move beyond purely statistical descriptions of forest growth to include more of the biology of how trees grow and how forests actually work.

Investigators: John D. Marshall, Andrew Robinson, Paul Gessler, and Katy Kavanagh

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Examples of research: belowground C allocation

Objective:

To use a carbon balance model approach to estimate production and turnover of fine roots and mycorrhizae

Background:

- fine root and mycorrhizal production is estimated to be 10 to 60% of NPP (one of the largest C inputs to forest soils)
- accurate measurement and prediction of the production and turnover of fine roots is essential for quantification of belowground C
- very difficult to measure

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C balance model: $TBCA = F_r + NPP_r$

(Raich and Nadelhoffer, 1989)

$$TBCA = F_{\text{fine roots}} + F_{\text{coarse roots}} + NPP_{\text{fine roots}} + NPP_{\text{coarse roots}}$$

$$NPP_{\text{fine roots}} = TBCA - F_{\text{fine roots}} - F_{\text{coarse roots}} - NPP_{\text{coarse roots}}$$

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Conclusions:

- estimates of fine root production have been underestimated in previous studies where mycorrhizae or exudates were not considered

- sensitivity analysis indicated the most important parameters were:

- measurements of soil-surface CO₂ flux
 - coarse root respiration
 - litter fall estimates

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Example: Tree response to climate change

Objective: To use chemical variation in tree rings (carbon and oxygen isotope ratios) to interpret tree responses to rising CO₂ and temperature.

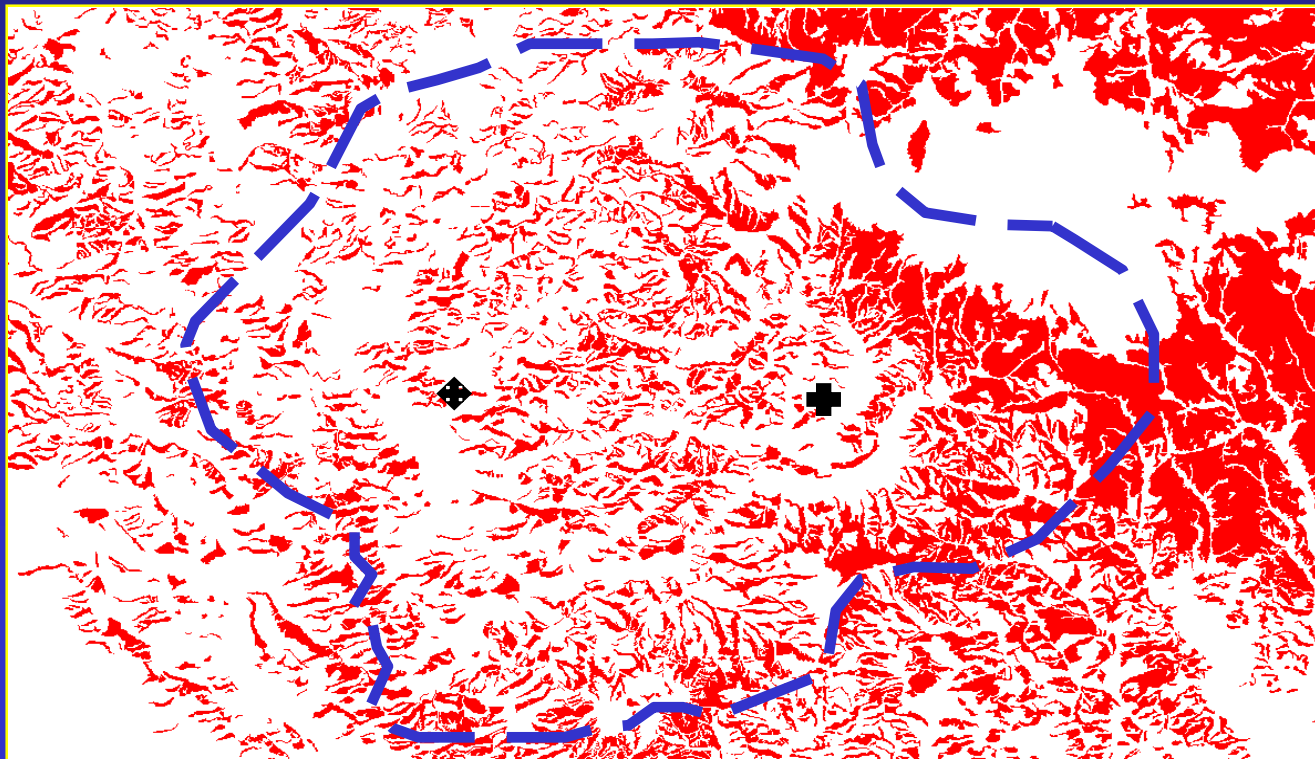
Work has been done on naturally growing conifers in Northern Idaho. In a recent collaborative effort with Swedish scientists, carbon and oxygen isotope ratios in tree rings are being studied in more controlled environments where trees are grown in chambers with elevated CO₂ levels.

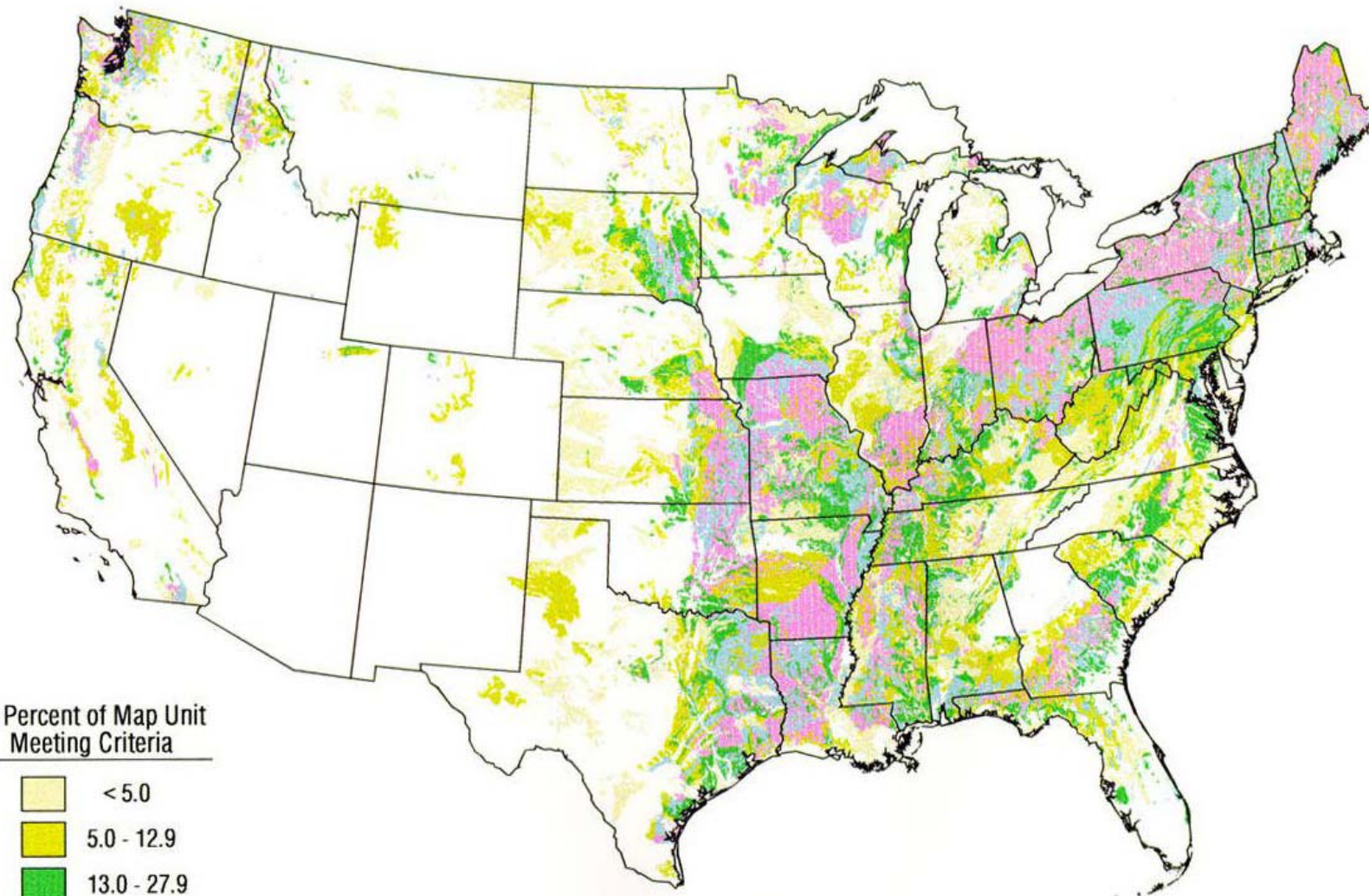
I. Improving our knowledge of C cycling

B. Influences of topography, management, and soil properties

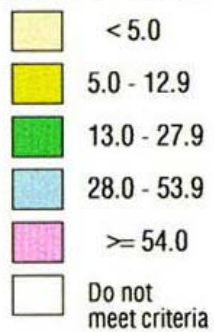
Example: Water restrictive horizons

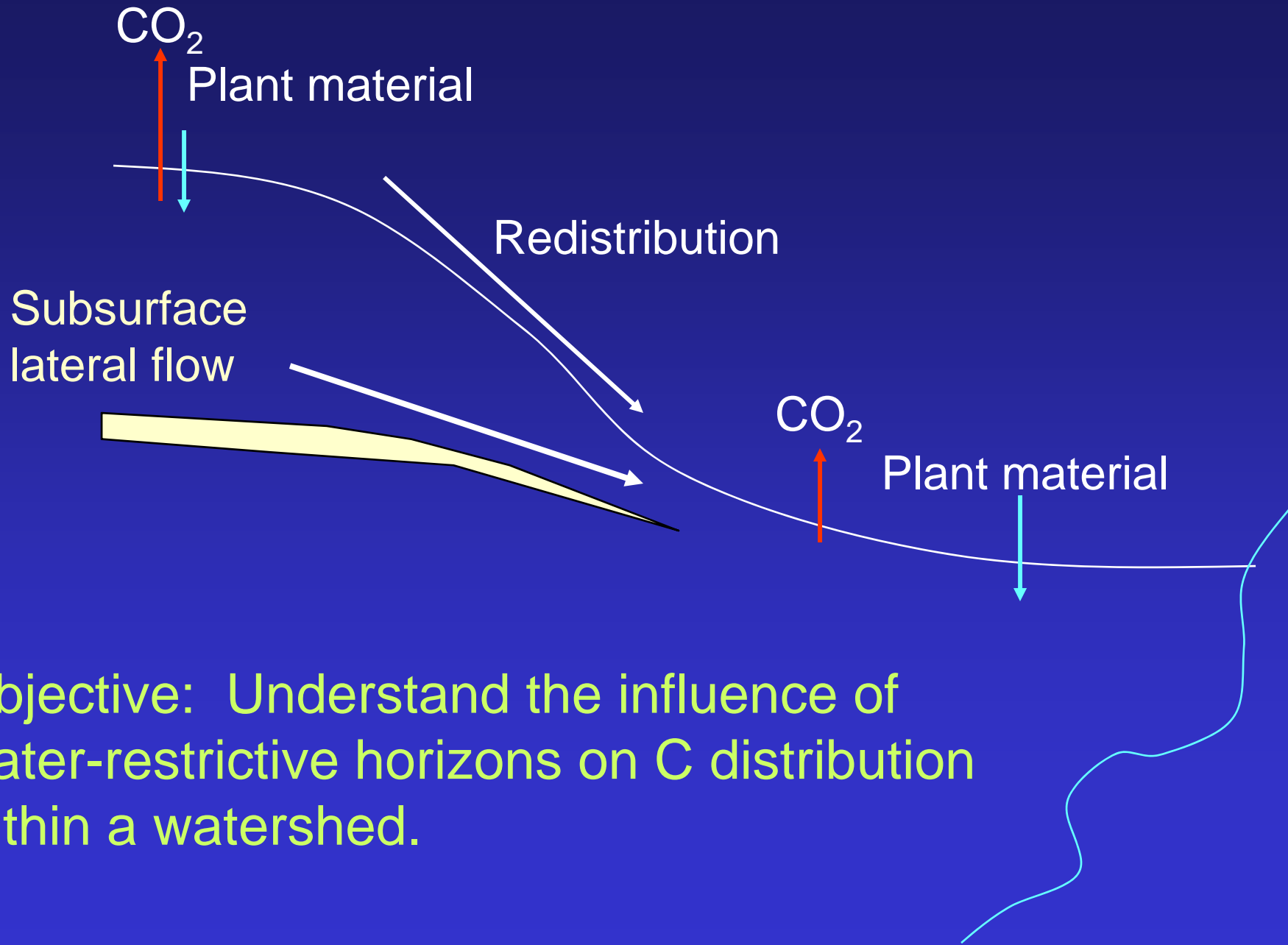
Moscow-
Pullman
basin





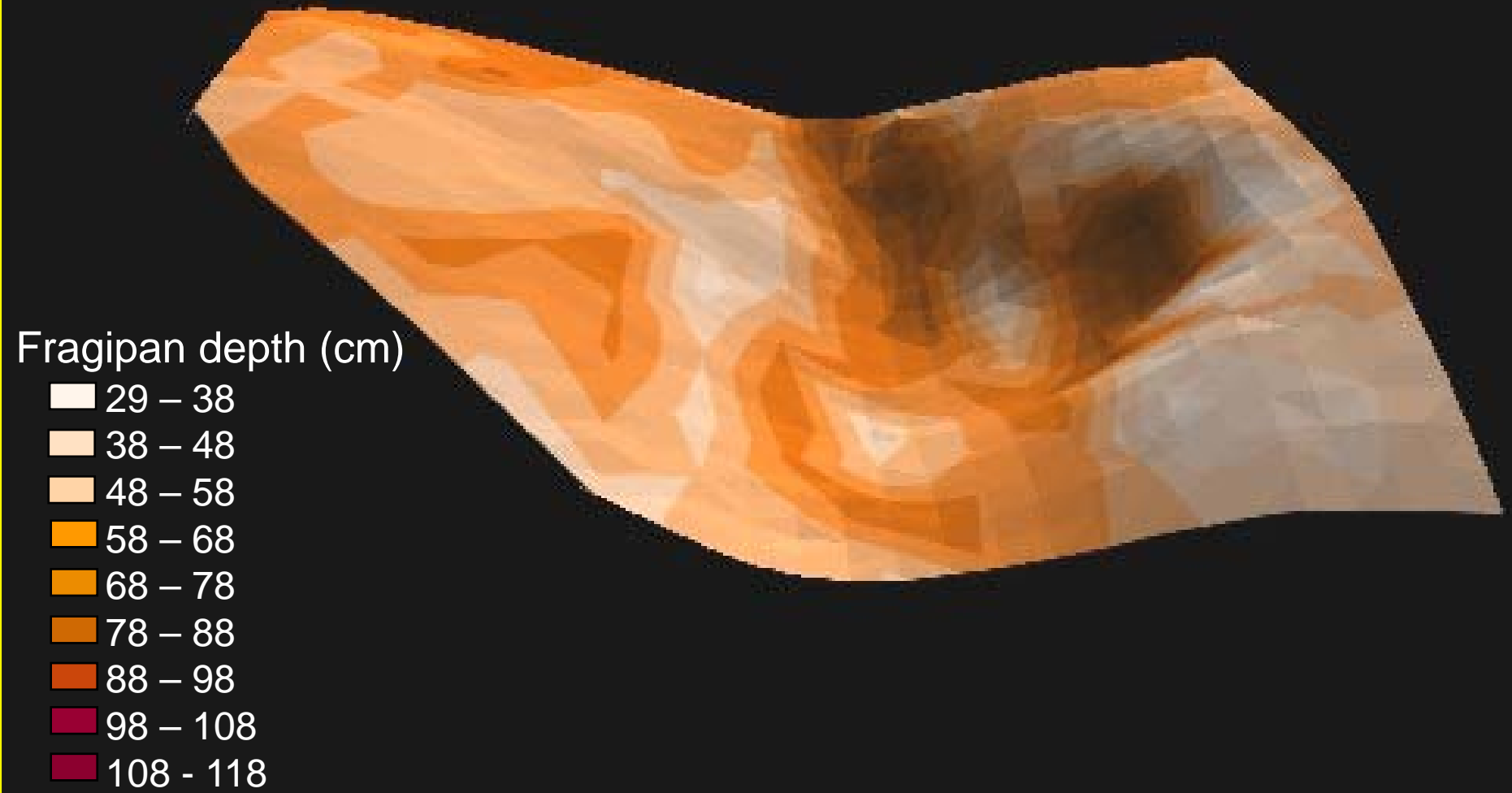
**Percent of Map Unit
Meeting Criteria**



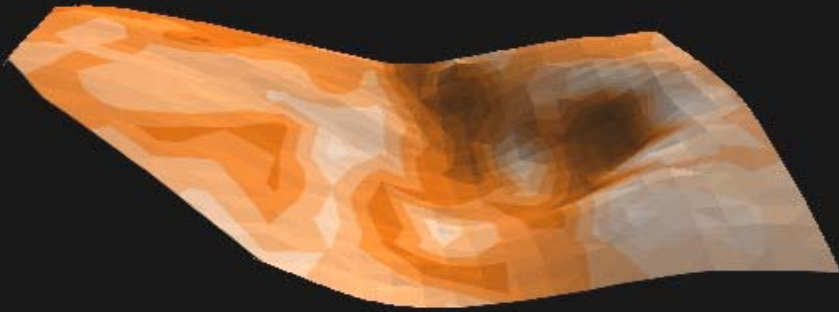


Objective: Understand the influence of water-restrictive horizons on C distribution within a watershed.

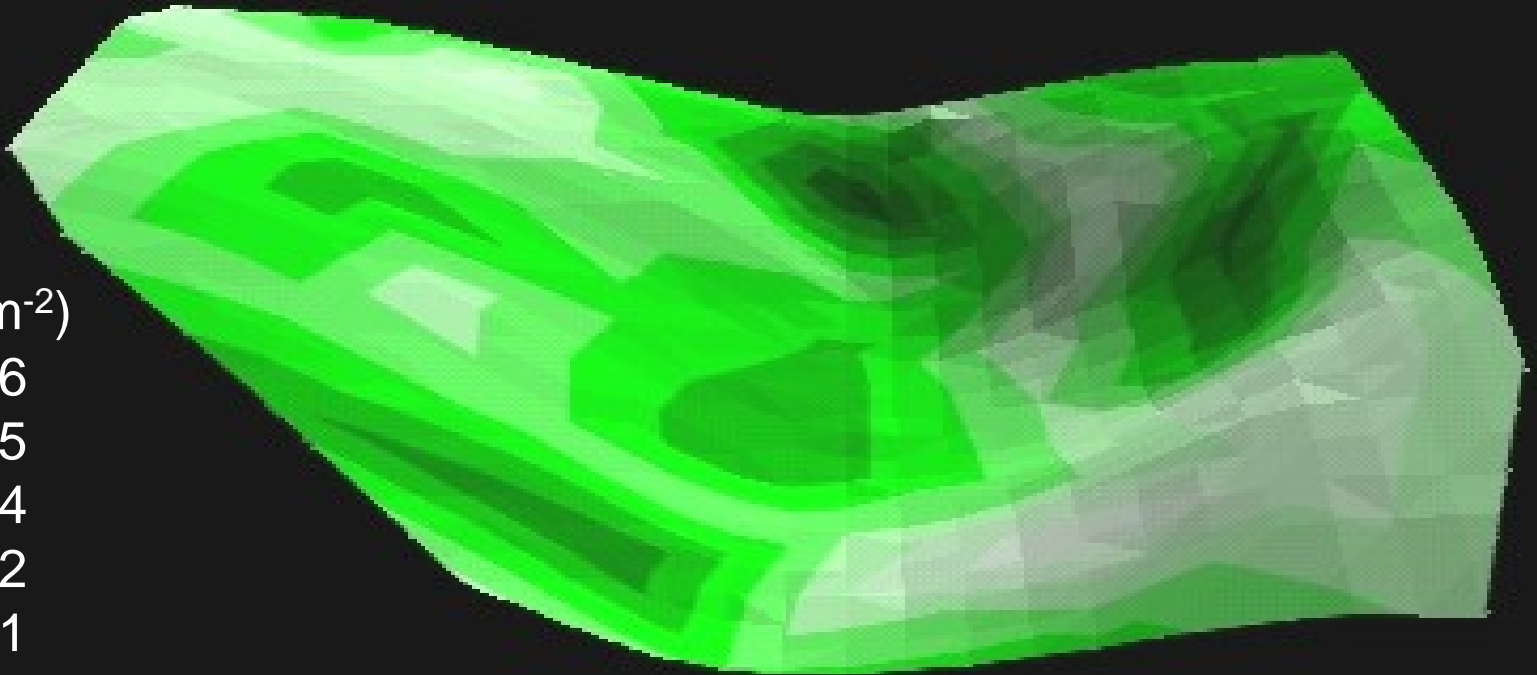
Depth to Fragipan

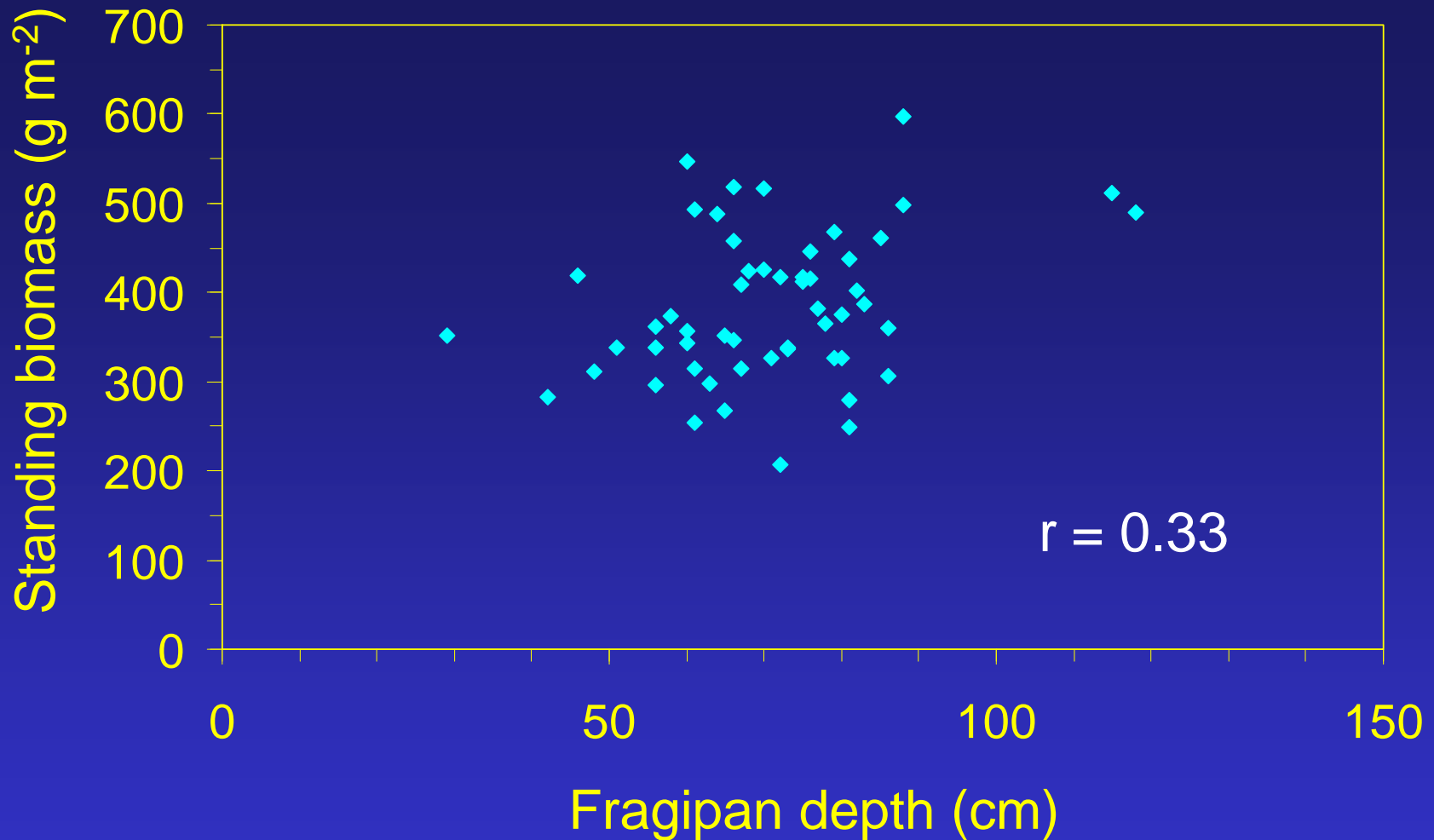


Standing biomass



Standing
biomass (gm^{-2})





aspect and biomass $r = -0.09$

slope and biomass $r = 0.07$

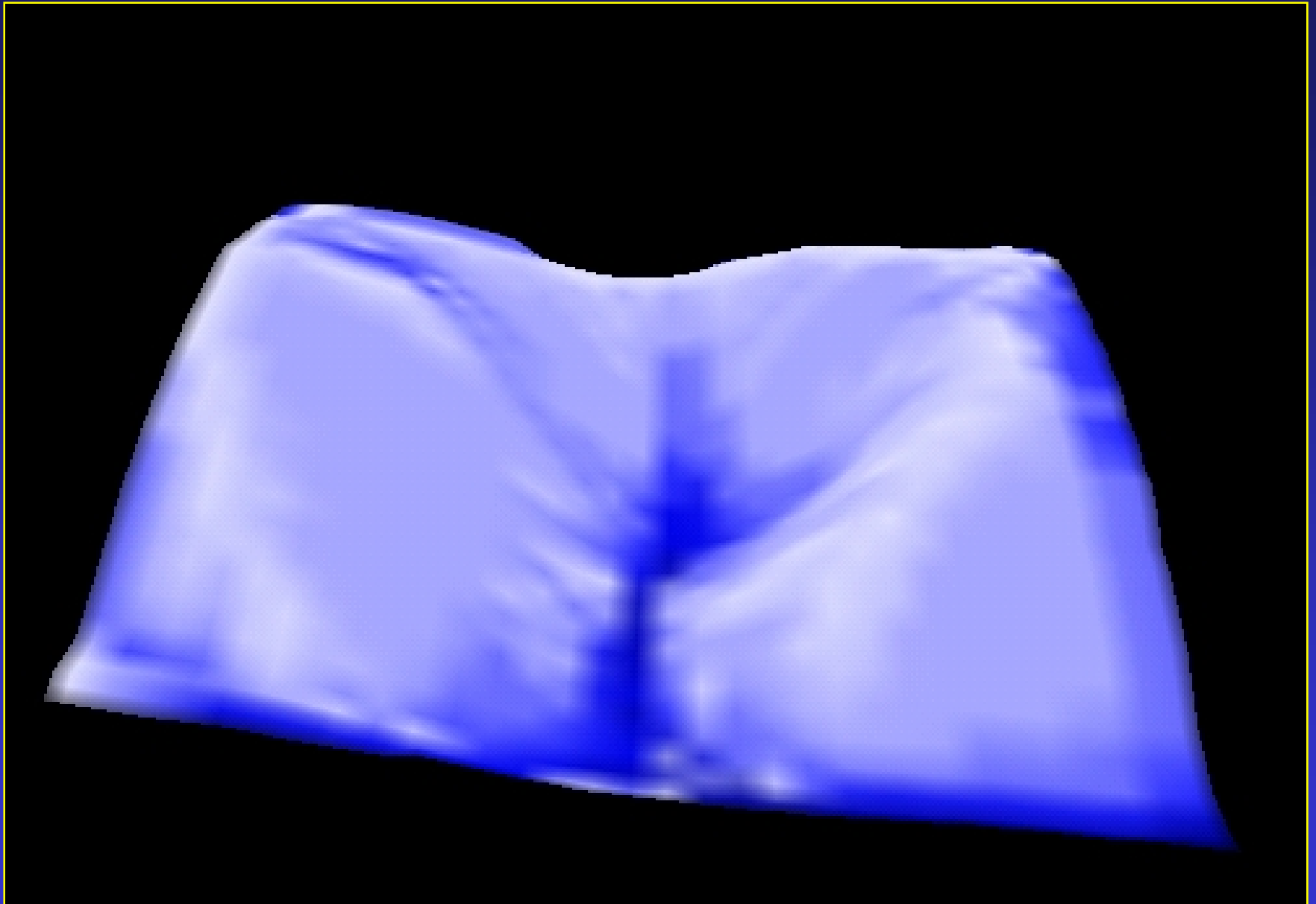
Compound Topographic Index (CTI)

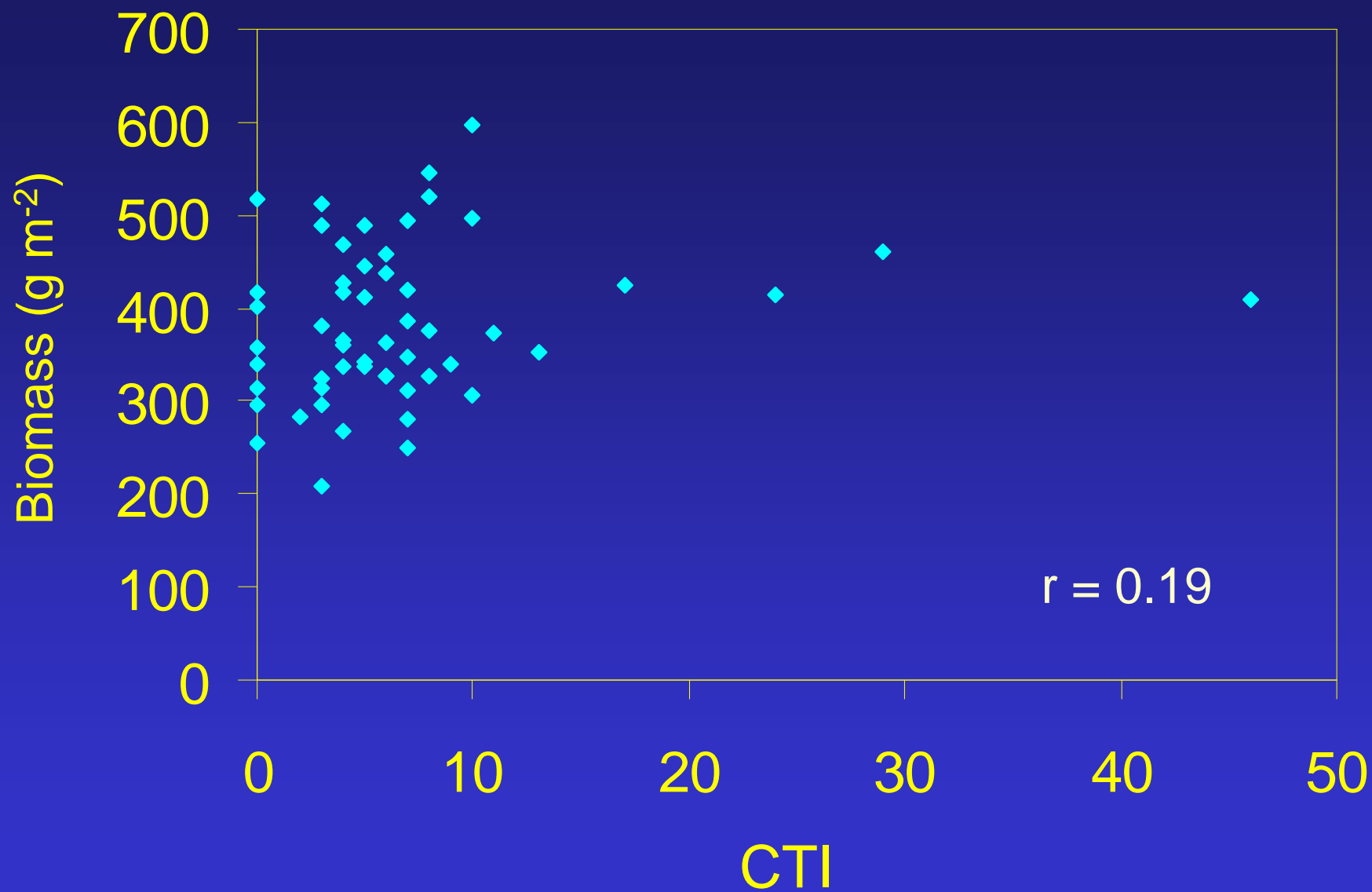
$$CTI = \ln \left(\frac{A_s}{\tan \beta} \right)$$

A_s = specific catchment area (m^2m^{-1})

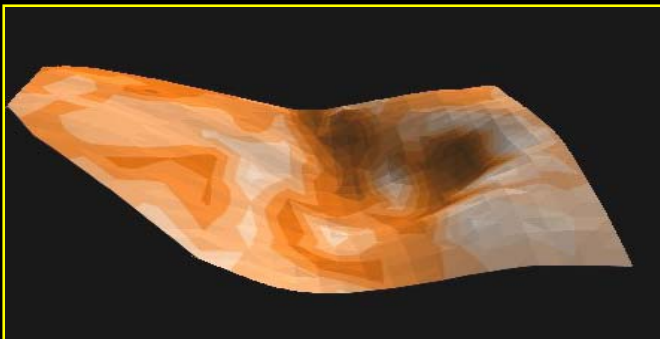
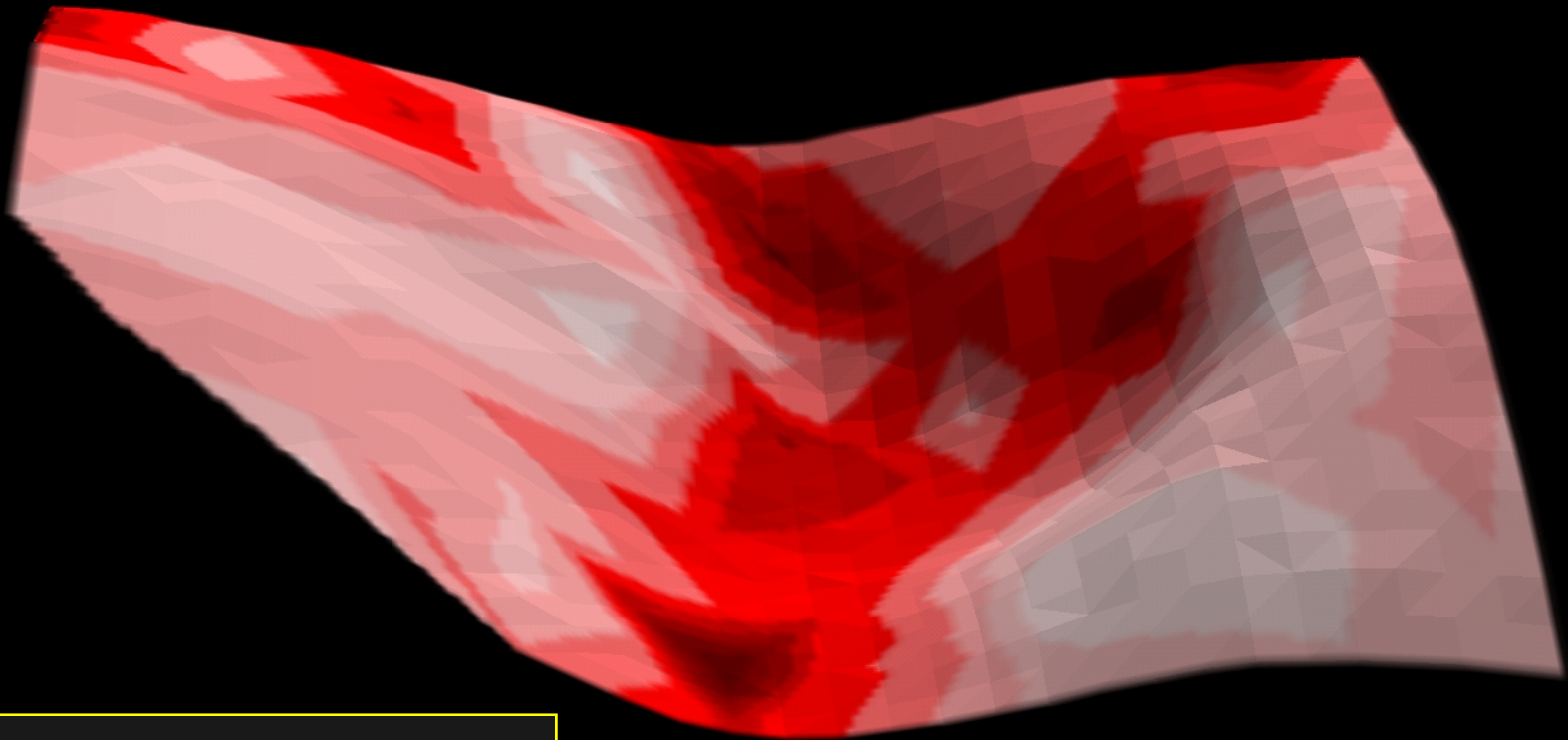
β = slope (degrees) at a given point

CTI

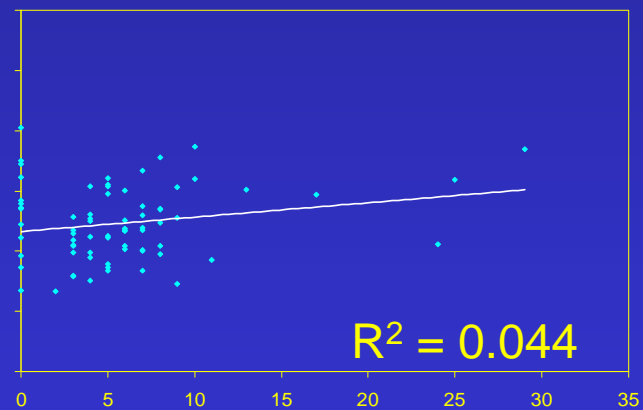
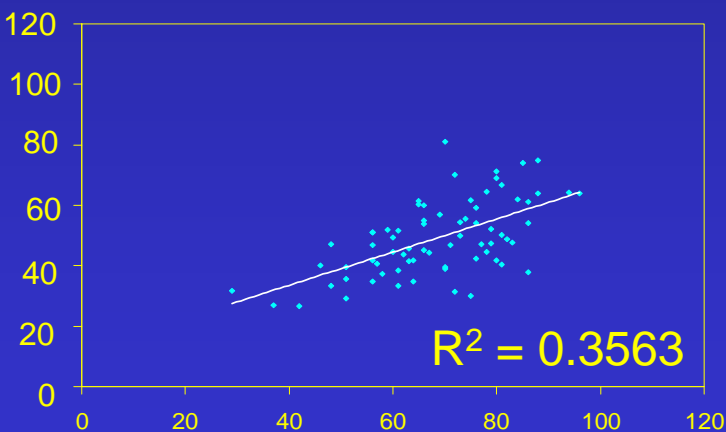
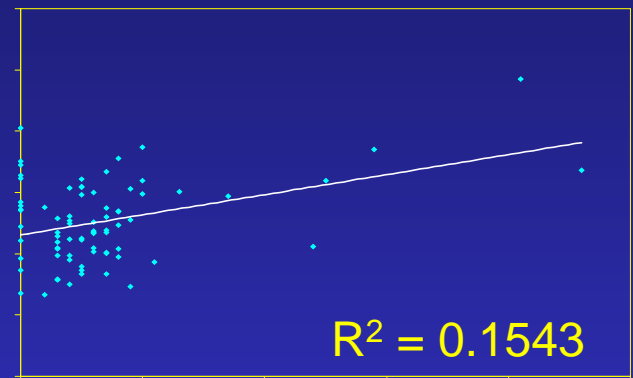
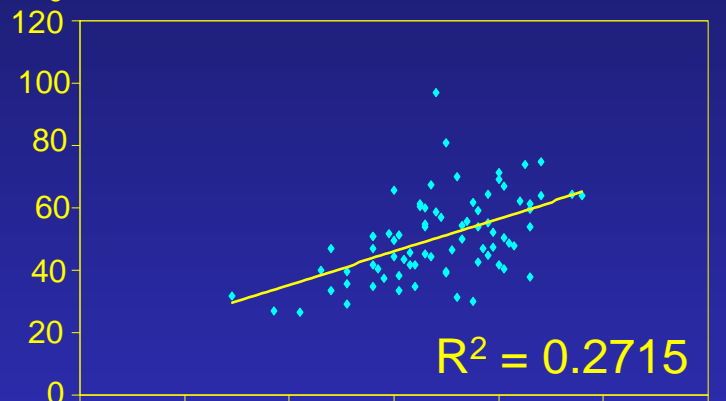
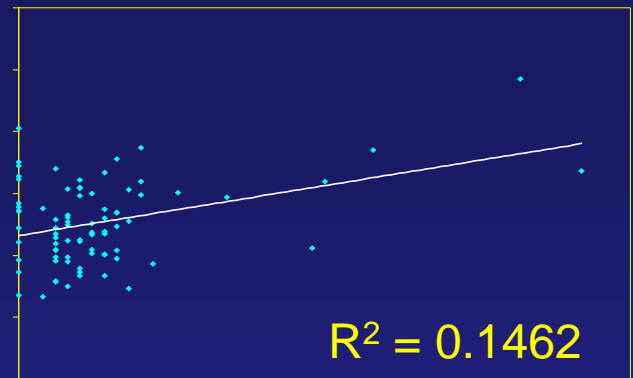
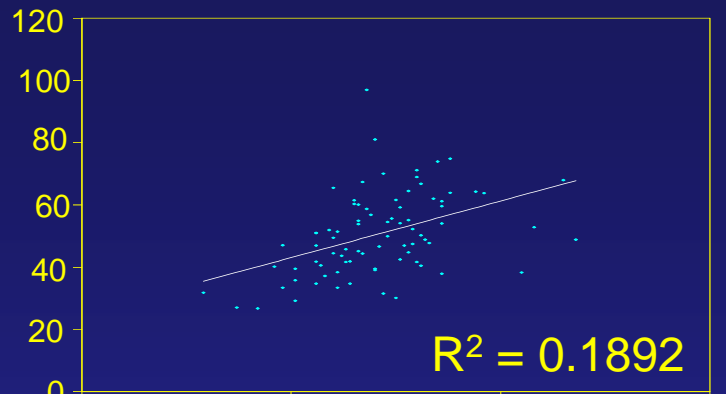




Cmass



Cmass (gm⁻²)



Fragipan depth (cm)

CTI

Conclusions:

- Fragipans influence the distribution of above-ground vegetation
- The distribution of C is best explained by using measurements of surface topography and subsurface morphology
- Variation in fragipan depth may not correspond to surface topography, and needs to be considered in models used to predict nutrient flows and C accumulation in landscapes where they are a common feature

Example: Influence of tillage and landscape position on C accumulation



Biodiesel Research

- Extensive program involving *Brassica* Species
- Developing mustard, canola, and rapeseed cultivars for biodiesel production in the US
- Agricultural uses
 - Soil fumigant
 - Nitrogen amendment
 - Weed control

Investigators: Jack Brown,
Matthew Morra,
Joseph McCaffery,
Jodi Johnson-Maynard



Meal as a soil amendment

